LWO Technology Development

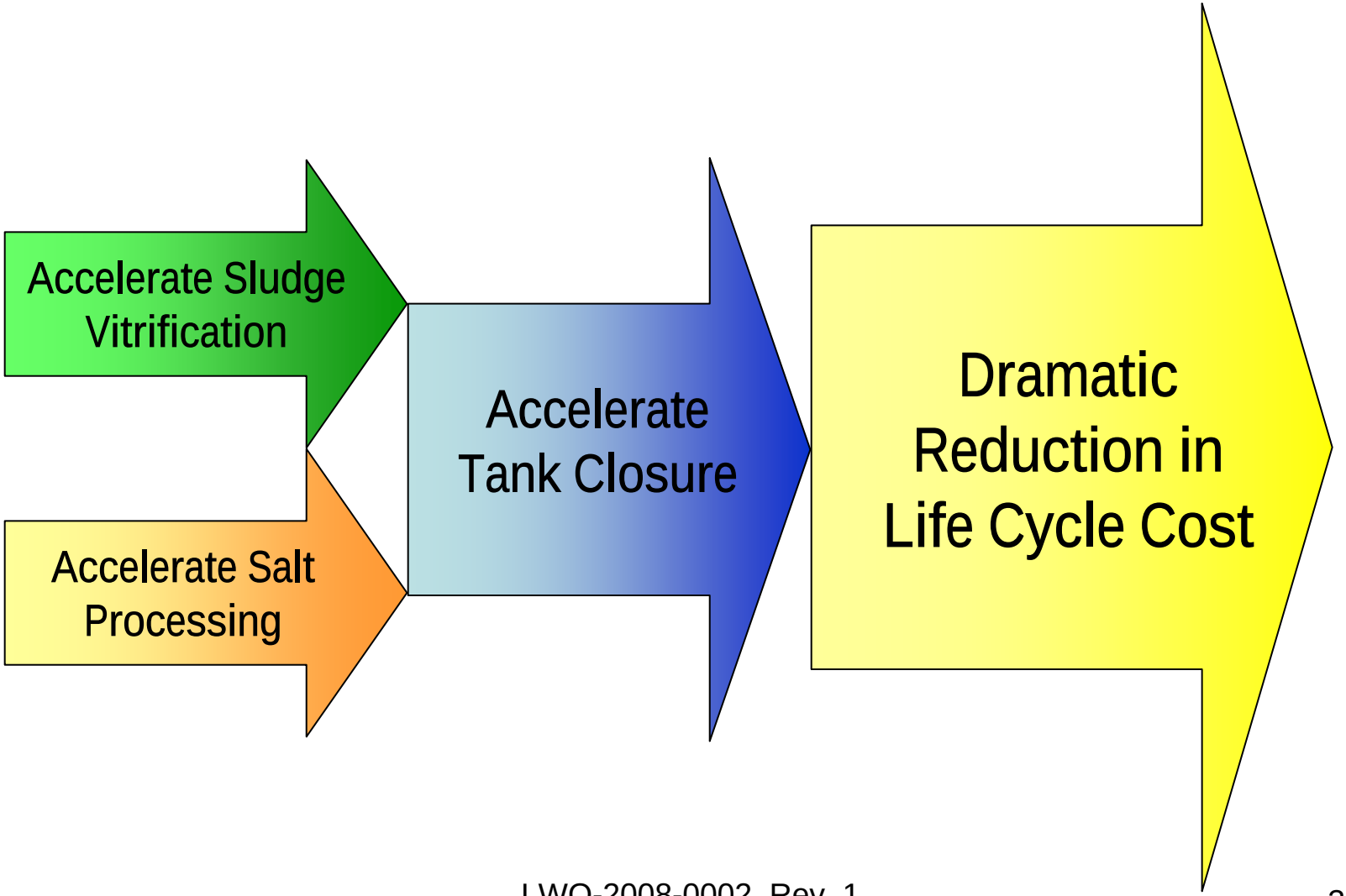
A presentation to
the National Academies of Science

Neil Davis
LWO Technology Development Manager
January 9, 2008

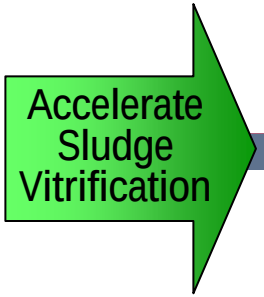
Introduction

- The Department has made a significant Technology Development investment at SRS to disposition HLW and to close HLW tanks
- Two tanks are closed with several more staged for closure by the end of FY08
- Sludge disposition is well underway
- Salt disposition will start in 2013 via the Salt Waste Processing facility
- Yet, there is still work to be done

Current Objective



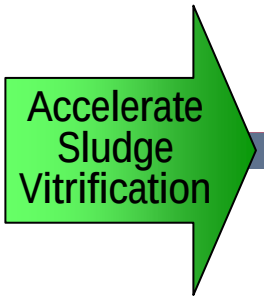
Accelerate Sludge Vitrification



There are 3 Technology Development elements:

- Increase waste loading in glass
- Increase DWPF throughput
- Improve sludge preparation and qualification in the Tank Farm

Increase Waste Loading



- Increasing the relative volume of sludge oxides in glass reduces the number of cans produced
- Significant improvements have been made since DWPF startup in 1996
- Tailored frit has increased waste loading from 34 to about 38 wt % without sacrificing glass quality

Increase DWPF Throughput

Accelerate Sludge Vitrification

- Increasing the rate at which DWPF produces glass reduces life cycle schedule and cost
- Each year of reduced operation can save as much as $500M!
- Several initiatives are in progress

  to increase melt rate:
  - Tailored frit (Ex: Frit 510)
  - Adding mixing to the existing joule-heated melter (Ex: Melter glass pump)
  - Increasing melt temperature via an alternative melter (CCIM)

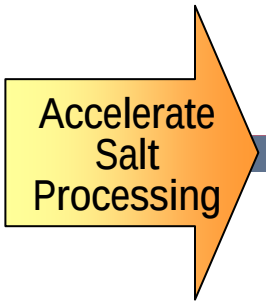
Figure 1: General view of the CCIM demonstration platform – CEA Marcoule

Accelerate Sludge Preparation

Accelerate Sludge Vitrification

- Increased DWPF throughput must be supported by accelerating TF sludge feed preparation
- Tank Farm (TF):
  - Aluminum dissolution
  - Sludge washing to remove Na salts
  - Limiting step is sludge settling
  - Rotary Microfilter can support a continuous wash

Accelerate Salt Processing

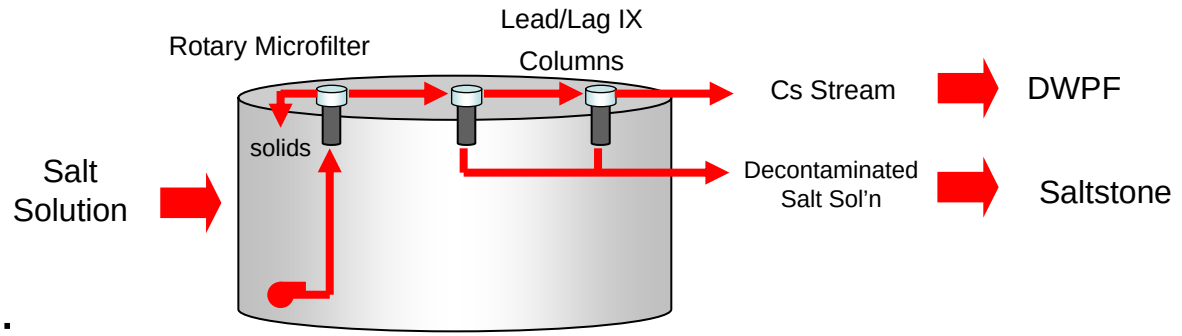


- Site Treatment Plan commitment is 2028
  - Planning basis shows salt processing completion is 2030
  - Salt processing completion is 2-5 years after sludge vitrification
- One way to accelerate salt processing is to augment SWPF with Small Column Ion Exchange
  - DOE has been maturing this technology for several years
  - It is now sufficiently mature to deploy with low risk
  - SCIX is designed as a retrofit into existing waste tanks to eliminate the need for new infrastructure
- There are 2 Technology Development elements:
  - Resin selection
  - Actinide removal

Resin Selection

Accelerate Salt Processing

- There are two DOE-developed resins that have a Cs-137 DF similar to SWPF:
  - Spherical Resorcinol Formaldehyde (RF)
  - Crystalline –Silico-Titanate (CST)



RF

CST

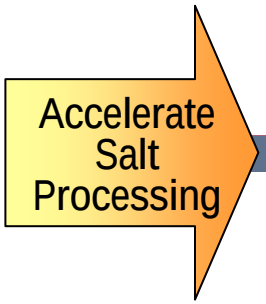
- RF:
  - Elutable, use for multiple cycles
  - Eluate is disposed of in glass (minimal additional canisters)
  - Spent resin disposed of as LLW
- CST:
  - non-elutable, use one cycle only
  - Loaded resin is disposed of in glass (additional canisters)

Actinide Removal

Accelerate Salt Processing

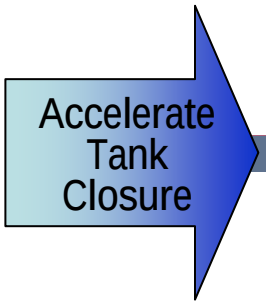
- The actinide and strontium concentration must be reduced to meet Saltstone waste acceptance criteria
- Modified monosodium titanate
  - Exhibits improved strontium and actinide removal
  - Potential increased throughput
- Rotary Microfilter
  - Higher filtrate flux than cross-flow filters
  - Less flux decay over time
  - Designed to be mounted in an existing tank riser

Accelerate Salt Processing

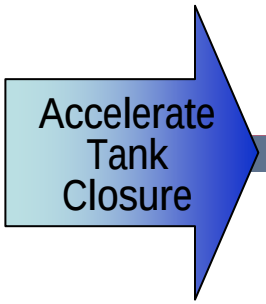


- DOE and SRS are developing the capability to deploy a Small Column Ion Exchange unit in an existing waste tank
  - Similar performance to SWPF
  - 50% of the throughput
- Potential to reduce the life cycle schedule by 5 years
  - $2.5B cost avoidance
- Technologies are maturing and can be deployed in ~3 years
- Significant regulatory work will be needed

Accelerate Tank Closure



- Removing waste as feed to DWPF and SWPF generates tank space that supports tank closure
- 24 non-compliant tanks must be closed per the FFA
  - 2 tanks are currently closed
  - 4 more will be ready for closure by the end of FY08
- The 2 closed tanks did not have an annulus or cooling coils nor were the transfer lines closed
- Also, advances have been made in groundwater modeling and grout formulation



Accelerate Tank Closure

There are 4 Technology development tasks:

- Cooling coil closure
- Transfer line closure
- Enhanced Groundwater Models
- Grout formulation

Cooling Coil and Transfer Line Closure

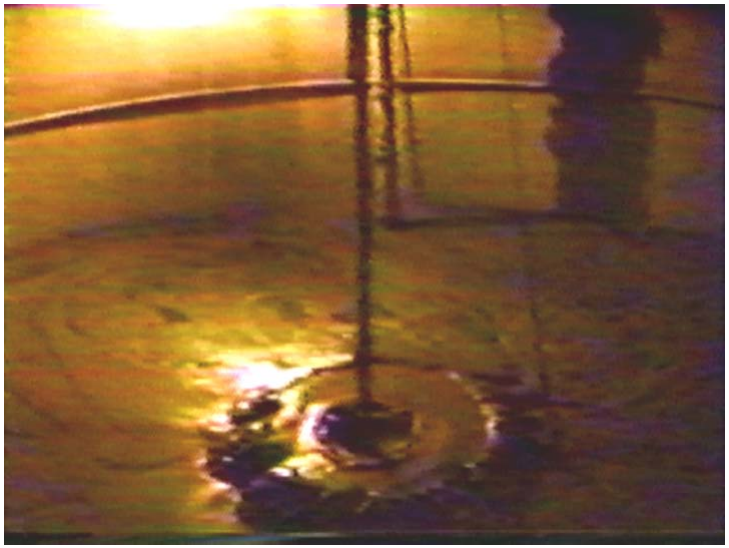
Accelerate Tank Closure

- 43 of the remaining tanks have extensive cooling coil systems
  - 2” diameter sch 40 pipe
  - Carbon steel
  - 20,000 to 25,000 feet of pipe per tank
  - The vertical runs represent “fast flowpaths” from near surface to residual waste on the tank bottom
  - These flowpaths must be eliminated
    - Filling with a stable material
    - Cutting
- The Tank Farm has an extensive waste transfer system
  - 3” diameter stainless steel core pipes
  - Carbon steel jackets/concrete encasements
  - > 200 segments
  - Closure required via regulatory documents
  - Requirements not clear
  - Precedent at INL
  - Several techniques being explored

Grout Formulation

Accelerate Tank Closure

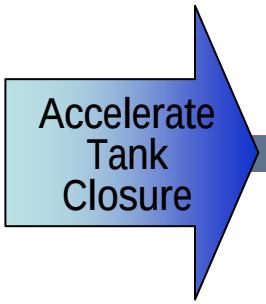
- The 2 closed tanks used a 3 layer grout system
  - Reducing grout at the bottom
  - CLSM in the middle
  - Strong grout at the top
- Improved grout formulations being developed
  - "All-Reducing" grout
  - Physical properties testing



Accelerated Tank Closure

- We are developing techniques for the double-shell tanks with cooling coils and transfer lines
- We will render tank closure down to a simple, repetitive process
- We will focus on closing groups of tanks vs. individual tanks as they are ready
  - Reduce the Operating workforce
  - Achieve economies of scale
  - Shut down areas of the tank farm
- We will meet and exceed FFA schedule requirements

Life Cycle Cost



- If SWPF is operating, then DWPF and Saltstone must operate
- If DWPF is operating, then the Tank Farm must operate
- If the Tank Farm is operating, then the ETF must operate
- Operation of the system costs about $500 M/year
- Running the system faster reduces Life Cycle Cost
- Salt Processing is critical path #1
- Sludge vitrification is critical path #2
- Our Technology Development program is designed to reduce the cost to the Department by accelerating waste treatment, waste disposition and tank closure